



Atty. Dkt. No. 023971-0407

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant: Takahiro HAMADA et al.  
Title: FUEL INJECTION VALVE  
Appl. No.: 10/823,773  
Filing Date: 04/14/2004  
Examiner: Mahmoud Gimie  
Art Unit: 3747  
Confirmation Number: 4680

**APPEAL BRIEF TRANSMITTAL**

Mail Stop Amendment  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Transmitted herewith is the following in the above-identified application.

☒ Brief on Appeal.

☒ Applicant hereby petitions for an extension of time under 37 C.F.R. §1.136(a) for the total number of months checked below:

<input checked="" type="checkbox"/> Extension for Brief filed within the first month:	\$120.00	\$120.00
EXTENSION FEE TOTAL:		\$120.00
<input checked="" type="checkbox"/> Appeal Fee Under 37 CFR 41.20(b)(2):	\$500.00	\$500.00
APPEAL BRIEF and EXTENSION FEE TOTAL:		\$620.00
<input type="checkbox"/> Small Entity Fees Apply (subtract 1/2 of above):		\$0.00
TOTAL FEE:		\$620.00

A credit card payment form in the amount of \$620.00 is enclosed.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by the credit card payment form being unsigned, providing incorrect information resulting in a rejected credit card transaction, or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741.

If any extensions of time are needed for timely acceptance of papers submitted herewith, applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Please direct all correspondence to the undersigned attorney or agent at the address indicated below.

Respectfully submitted,

Date May 16, 2007

By  \_\_\_\_\_

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Atty. Dkt. No. 023971-0407

***IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES***

Applicant: Takahiro HAMADA et al.  
Title: FUEL INJECTION VALVE  
Appl. No.: 10/823,773  
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Confirmation Number: 4680

**BRIEF ON APPEAL**

Mail Stop Appeal Brief - Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Under the provisions of 37 C.F.R. § 41.37, this Appeal Brief is being filed together with a credit card payment form in the amount of \$500.00 covering the 37 C.F.R. 41.20(b)(2) appeal fee. If this fee is deemed to be insufficient, authorization is hereby given to charge any deficiency (or credit any balance) to the undersigned deposit account 19-0741.

**REAL PARTY IN INTEREST**

The real party in interest is NISSAN MOTOR CO., Ltd. of Japan.

**RELATED APPEALS AND INTERFERENCES**

Appellants are unaware of any appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in the present appeal.

05/17/2007 HMARZI1 00000047 10023773  
01 FC:1402 500.00 OP

05/17/2007 HMARZI1 00000047 10023773  
02 FC:1251 120.00 OP

**STATUS OF CLAIMS**

1. Claims pending: 1-7.
2. Claims withdrawn: NONE
3. Claims cancelled: NONE
4. Claims rejected: 1-7.
5. Claims on appeal: 1-7.

A copy of claims 1-7 on appeal is provided in the CLAIMS APPENDIX. All of these claims have been finally rejected.

**STATUS OF AMENDMENTS**

Applicants have filed no claim amendments subsequent to the issuance of the Final Rejection dated August 16, 2006. On September 6, 2006, Applicants submitted a replacement drawing sheet in response to a Notice of Non-Compliant Amendment dated August 11, 2006. The PTO has not yet indicated whether the replacement drawing sheet has been accepted and entered.

**SUMMARY OF CLAIMED SUBJECT MATTER**

According to a presently claimed embodiment, there has been provided a fuel injection valve comprising a needle valve including a base material; an opposite member including a base material whose sliding section is in slidable contact with a sliding section of the base material of the needle valve in presence of fuel for an automotive vehicle; and a hard carbon thin film coated on at least one of the sliding sections of the base materials of the needle valve and the opposite member. The hard carbon thin film has a surface hardness ranging from 1500 to 4500 kg/mm<sup>2</sup> in Knoop hardness, a film thickness ranging from 0.3 to 2.0  $\mu$ m, and a surface roughness (Ry) ( $\mu$ m) which satisfies a relationship represented by the following formula (A):

$$R_y < (0.75 - H_k/8000) \times h + 0.0875 \dots (A)$$

where h is the thickness ( $\mu\text{m}$ ) of the hard carbon thin film; and Hk is the surface hardness in Knoop hardness ( $\text{kg}/\text{mm}^2$ ) of the hard carbon thin film. (Specification, p. 4, ll. 9-23).

According to another claimed embodiment, there has been provided a fuel injection valve wherein the fuel for an automotive vehicle contains at least one additive selected from the group consisting of an ester-based additive and an amine-based additive. (Specification, p. 5, ll. 20-28).

According to another claimed embodiment, there has been provided a fuel injection valve wherein the at least one additive is at least one additive selected from the group consisting of octane booster, cetane booster, antioxidant, metal deactivator, detergent-dispersant, deicing agent, and corrosion inhibitor. (Specification, p. 5, ll. 11-28).

According to another claimed embodiment, there has been provided a fuel injection valve wherein the hard carbon thin film contains hydrogen atom in an amount of not more than 0.5 atomic %. (Specification, p. 10, l. 26 – p. 11, l. 4).

According to another claimed embodiment, there has been provided a fuel injection valve wherein the hard carbon thin film is a diamond-like carbon thin film. (Specification, p. 6, ll. 17-21).

According to another claimed embodiment, there has been provided a fuel injection valve wherein the diamond-like carbon film is formed by an arc ion plating process. (Specification, p. 6, ll. 17-21).

According to another claimed embodiment, there has been provided a fuel injection valve wherein the at least one of the sliding sections of the base materials of the needle valve and the opposite member has a surface roughness (Ra) of not more than  $0.03 \mu\text{m}$  in a condition before the at least one of the sliding sections is coated with the hard carbon thin film. (Specification (p. 9, l. 22 – p. 10, l. 3).

#### **GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

In this Appeal, Applicants request review of the following grounds of rejections set forth in the Final Office Action dated August 16, 2006:

(1) the rejection of pending claims 1-7 under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent 6,715,693 to Dam *et al.* (hereafter “Dam”);

(2) the rejection of pending claims 2-7 under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent 6,715,693 to Dam *et al.* (hereafter “Dam”) in view of U.S. Patent 6,514,298 to Haji *et al.* (hereafter “Haji”);

(3) the rejection of pending claims 1-7 under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent 6,156,439 to Coffinberry (hereafter “Coffinberry”); and

(4) the rejection of pending claims 2-7 under 35 U.S.C. §103(a) as allegedly being unpatentable over Coffinberry in view of Haji.

## **ARGUMENT**

### **I. The Board Should Reverse the Rejection Under 35 U.S.C. §103(a) Based Upon Dam**

On page 2 of the Final Office Action dated August 16, 2006, the PTO has rejected claims 1-7 under 35 U.S.C. §103(a) as allegedly being obvious over U.S. Patent 6,715,693 to Dam *et al.* (hereafter “Dam”). Applicants respectfully traverse this rejection for the reasons set forth below.

#### **A. Claims 1-7**

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, prior art references must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must

both be found in the prior art, not in Applicants' disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

Here, Applicants submit that Dam fails to teach or suggest "a surface roughness ( $R_y$ ) ( $\mu\text{m}$ ) which satisfies a relationship represented by the following formula (A):  $R_y < (0.75 - H_k/8000) \times h + 0.0875$  (A)" as recited in claim 1. In this regard, Applicants wish to note (1) that formula (A) defines a relationship between 3 variables ( $R_y$ ,  $H_k$ , and  $h$ ), (2) that  $R_y$  (surface roughness),  $H_k$  (hardness), and  $h$  (thickness) are *independent* variables and (3) that the PTO's rejections are completely missing the constants defined in formula (A) which were empirically derived by the present inventors as part of their research into the interplay between 3 independent variables.

In view of these comments, Applicants wish to point out that Dam fails to disclose any values for the surface roughness  $R_y$  of a hard carbon coating.

Applicants note that the range of claimed surface roughnesses defined by relationship "(A)" are not the "automatic" result of forming a film having a surface hardness ( $H_k$ ) and thickness ( $h$ ) within the presently claimed ranges as suggested by the PTO, *i.e.* the hardness and thickness of a film are not the sole determinants of the film's surface roughness. Even if they were, such a conflation of the concepts of *inherency* and *obviousness* is improper and cannot provide the bases for a proper obviousness rejection.

The only references to surface roughness in Dam appear at col. 1, line 67-col. 2, line 5 and at col. 7, ll. 1-7, and both of these very general references appear to relate only to the surface roughness of uncoated materials.

In the "Response to Arguments" section on page 5 of the Final Office Action dated August 16, 2006, the PTO has suggested:

(i) that Dam discloses values for surface hardness ( $H_k$ ) and film thickness ( $h$ ) that fall within or overlap the presently claimed ranges and

(ii) that, as a result, Dam must also disclose the claimed values for  $R_y$  because the formula in claim 1 includes only 3 variables.

Applicants respectfully disagree. The conclusion in (ii) is based upon the incorrect presumption that the presently claimed formula is a mathematical equation. In a mathematical equation with 3 variables, it is easily possible to calculate the value for a third variable if the

values for the other 2 variables are known. For example, in the equation:  $A + B = C$ , if  $A = 2$  and  $B = 3$ , then the value for  $C$  must be 5.

Here, knowledge of values for 2 of the variables in the formula does not automatically result in knowledge of the values for the third variable, *i.e.* it is possible to produce films having surface hardness ( $H_k$ ) and thickness ( $h$ ) values which fall within the claimed range but with a surface roughness that falls outside the relationship defined by the formula (A) set forth in claim 1. This is due to the presence of the mathematical symbol "<" in the formula instead of the symbol "=", *i.e.* the formula is an inequality rather than an equation. Moreover, the formula in claim 1 was defined by the present inventors and appears nowhere in any of the cited references.

Thus, Applicants submit that the outstanding rejection of claim 1 is improper and ought to be reversed.

With regard to claim 2, Applicants submit that Dam fails to teach or suggest a fuel injector comprising a hard carbon film "wherein the fuel for an automotive vehicle contains at least one additive selected from the group consisting of an ester-based additive and an amine-based additive" in combination with the features of claim 1.

With regard to claim 3, Applicants submit that Dam fails to teach or suggest a fuel injector comprising a hard carbon film "wherein the at least one additive is at least one additive selected from the group consisting of octane booster, cetane booster, antioxidant, metal deactivator, detergent-dispersant, deicing agent, and corrosion inhibitor" in combination with the features of claims 1 and 2.

With regard to claim 4, Applicants submit that Dam fails to teach or suggest a fuel injector comprising a hard carbon film "wherein the hard carbon thin film contains hydrogen atom in an amount of not more than 0.5 atomic %" in combination with the features of claim 1.

With regard to claim 5, Applicants submit that Dam fails to teach or suggest a fuel injector comprising a hard carbon film "wherein the hard carbon thin film is a diamond-like carbon thin film" in combination with the features of claim 1.

With regard to claim 6, Applicants submit that Dam fails to teach or suggest a fuel injector comprising a hard carbon film "wherein the diamond-like carbon film is formed by an arc ion plating process" in combination with the features of claims 1 and 5.



With regard to claim 7, Applicants submit that Dam fails to teach or suggest a fuel injector comprising a hard carbon film “wherein the at least one of the sliding sections of the base materials of the needle valve and the opposite member has a surface roughness (Ra) of not more than 0.03  $\mu\text{m}$  in a condition before the at least one of the sliding sections is coated with the hard carbon thin film” in combination with the features of claim 1.

In view of the foregoing, Applicants respectfully request reversal of the outstanding rejections under §103 based upon Dam.

## **II. The Board Should Reverse the Rejection Under 35 U.S.C. §103(a) Based Upon Dam in View of Haji**

On page 3 of the Final Office Action dated August 16, 2006, the PTO has rejected claims 2-7 under 35 U.S.C. §103(a) as allegedly being unpatentable over Dam in view of U.S. Patent 6,514,298 to Haji *et al.* (hereafter “Haji”). Applicants respectfully traverse this rejection for the reasons set forth below.

### A. Claims 2-7

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, prior art references must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in Applicants’ disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

Here, Applicants submit that Dam and Haji, whether taken individually or in combination, fail to teach or suggest “a surface roughness (Ry) ( $\mu\text{m}$ ) which satisfies a relationship represented by the following formula (A):  $Ry < (0.75 - Hk/8000) \times h + 0.0875$  (A)” as recited in claim 1. In this regard, Applicants wish to note (1) that formula (A) defines a relationship between 3 variables (Ry, Hk, and h), (2) that Ry (surface roughness), Hk (hardness), and h (thickness) are *independent* variables and (3) that the PTO’s rejections are

completely missing the constants defined in formula (A) which were empirically derived by the present inventors as part of their research into the interplay between 3 independent variables.

In view of these comments, Applicants wish to point out that Dam fails to disclose any values for the surface roughness  $R_y$  of a hard carbon coating.

Applicants note that the range of claimed surface roughnesses defined by relationship “(A)” are not the “automatic” result of forming a film having a surface hardness ( $H_k$ ) and thickness ( $h$ ) within the presently claimed ranges as suggested by the PTO, *i.e.* the hardness and thickness of a film are not the sole determinants of the film’s surface roughness. Even if they were, such a conflation of the concepts of *inherency* and *obviousness* is improper and cannot provide the bases for a proper obviousness rejection.

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(i) that Dam discloses values for surface hardness ( $H_k$ ) and film thickness ( $h$ ) that fall within or overlap the presently claimed ranges and

(ii) that, as a result, Dam must also disclose the claimed values for  $R_y$  because the formula in claim 1 includes only 3 variables.

Applicants respectfully disagree. The conclusion in (ii) is based upon the incorrect presumption that the presently claimed formula is a mathematical equation. In a mathematical equation with 3 variables, it is easily possible to calculate the value for a third variable if the values for the other 2 variables are known. For example, in the equation:  $A + B = C$ , if  $A = 2$  and  $B = 3$ , then the value for  $C$  must be 5.

Here, knowledge of values for 2 of the variables in the formula does not automatically result in knowledge of the values for the third variable, *i.e.* it is possible to produce films having surface hardness ( $H_k$ ) and thickness ( $h$ ) values which fall within the claimed range but with a surface roughness that falls outside the relationship defined by the formula (A) set forth in claim 1. This is due to the presence of the mathematical symbol “ $<$ ” in the formula instead of the symbol “ $=$ ”, *i.e.* the formula is an inequality rather than an equation. Moreover,

the formula in claim 1 was defined by the present inventors and appears nowhere in any of the cited references.

Applicants note that Haji has been cited for the laundry lists of fuel additives which it contains and cannot resolve the basic deficiencies in Dam. Applicants therefore submit that Dam and Haji cannot properly render claim 1 obvious within the meaning of §103.

With particular regard to claims 2 and 3, Applicants submit that a person of ordinary skill in the art would not have been motivated to pick and choose from among the laundry lists of Haji to arrive at the presently claimed combination of features present in claims 1, 2, and 3.

With regard to claims 4-7, Applicants note that Dam does not disclose the individual features defined in each of these claims and Haji, a reference directed to fuel additives, contains no disclosure relevant to any of claims 4-7 which are directed to hard carbon coatings and the surface to which a hard carbon coating is applied. Accordingly, Haji adds nothing to resolve these fundamental deficiencies in Dam.

In view of the foregoing, Applicants respectfully request reversal of the outstanding rejections under §103 based upon Dam and Haji.

### **III. The Board Should Reverse the Rejection Under 35 U.S.C. §103(a) Based Upon Coffinberry**

On page 3 of the Office Action dated August 16, 2006, the PTO has rejected claims 1-7 under 35 U.S.C. §103(a) as allegedly being obvious over U.S. Patent 6,156,439 to Coffinberry (hereafter "Coffinberry"). Applicants respectfully traverse this rejection for the reasons set forth below.

#### **A. Claims 1-7**

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, prior art references must teach or suggest all the claim limitations. The teaching or

suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in Applicants' disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

Here, Applicants submit that Coffinberry fails to teach or suggest a "hard carbon thin film having a surface hardness ranging from 1500 to 4500 kg/mm<sup>2</sup> in Knoop hardness" as recited in claim 1. In this regard, Applicants wish to note (1) that formula (A) defines a relationship between 3 variables (Ry, Hk, and h), (2) that Ry (surface roughness), Hk (hardness), and h (thickness) are *independent* variables and (3) that the PTO's rejections are completely missing the constants defined in formula (A) which were empirically derived by the present inventors as part of their research into the interplay between 3 independent variables.

In view of these comments, Applicants wish to point out that Coffinberry fails to disclose any values for surface hardness (Hk), and certainly fails to disclose the presently claimed range. Further, the claimed range for surface hardness (Hk) is not the "automatic" result of forming a film having a surface roughness (Ry) and thickness (h) that fall within the claimed formula, as suggested by the PTO.

As with the rejections based upon Dam, the PTO has taken the position that knowledge of 2 variables (here surface roughness and film thickness) automatically results in knowledge of the third variable (surface hardness). This is the same flawed reasoning as was applied in the rejections based upon Dam.

Applicants also note that the cover of the Coffinberry patent indicates that it is assigned to General Electric Company and that the disclosure appears to focus on problems caused by buildup of coke and gum on walls within jet and gas turbine engines. (See col. 2, line 65-col. 3, line 18). Although there is a passing reference to a fuel injector (See col. 3, line 14), there is no discussion of coating sliding structures within the fuel injectors or solving the problems addressed in the present patent application. The remainder of Coffinberry's disclosure discusses coatings on walls. (See col. 5, lines 13-25). Thus, Applicants also submit that Coffinberry also fails to disclose "a hard carbon thin film coated on at least one of the sliding sections of the base materials of the needle valve and the opposite member" as recited in claim 1.

With regard to claim 2, Applicants submit that Coffinberry fails to teach or suggest a fuel injector comprising a hard carbon film “wherein the fuel for an automotive vehicle contains at least one additive selected from the group consisting of an ester-based additive and an amine-based additive” in combination with the features of claim 1.

With regard to claim 3, Applicants submit that Coffinberry fails to teach or suggest a fuel injector comprising a hard carbon film “wherein the at least one additive is at least one additive selected from the group consisting of octane booster, cetane booster, antioxidant, metal deactivator, detergent-dispersant, deicing agent, and corrosion inhibitor” in combination with the features of claims 1 and 2.

With regard to claim 4, Applicants submit that Coffinberry fails to teach or suggest a fuel injector comprising a hard carbon film “wherein the hard carbon thin film contains hydrogen atom in an amount of not more than 0.5 atomic %” in combination with the features of claim 1.

With regard to claim 5, Applicants submit that Coffinberry fails to teach or suggest a fuel injector comprising a hard carbon film “wherein the hard carbon thin film is a diamond-like carbon thin film” in combination with the features of claim 1.

With regard to claim 6, Applicants submit that Coffinberry fails to teach or suggest a fuel injector comprising a hard carbon film “wherein the diamond-like carbon film is formed by an arc ion plating process” in combination with the features of claims 1 and 5.

With regard to claim 7, Applicants submit that Coffinberry fails to teach or suggest a fuel injector comprising a hard carbon film “wherein the at least one of the sliding sections of the base materials of the needle valve and the opposite member has a surface roughness (Ra) of not more than 0.03  $\mu\text{m}$  in a condition before the at least one of the sliding sections is coated with the hard carbon thin film” in combination with the features of claim 1.

As a result, Applicants believe that the PTO's rejection based upon Coffinberry is improper and should be reversed.

In view of the foregoing, Applicants respectfully request reversal of the outstanding rejection based upon Coffinberry.

#### **IV. The Board Should Reverse the Rejection Under 35 U.S.C. §103(a) Based Upon Coffinberry in View of Haji**

On page 4 of the Final Office Action dated August 16, 2006, the PTO has rejected claims 2-7 under 35 U.S.C. §103(a) as allegedly being unpatentable over Coffinberry in view of Haji. Applicants respectfully traverse this rejection for the reasons set forth below.

##### A. Claims 2-7

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, prior art references must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in Applicants' disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

Here, Applicants submit that Coffinberry and Haji, whether taken individually or in combination, fail to teach or suggest "hard carbon thin film having a surface hardness ranging from 1500 to 4500 kg/mm<sup>2</sup> in Knoop hardness" as recited in claim 1. In this regard, Applicants wish to note (1) that formula (A) defines a relationship between 3 variables (Ry, Hk, and h), (2) that Ry (surface roughness), Hk (hardness), and h (thickness) are *independent* variables and (3) that the PTO's rejections are completely missing the constants defined in formula (A) which were empirically derived by the present inventors as part of their research into the interplay between 3 independent variables.

In view of these comments, Applicants wish to point out that Coffinberry fails to disclose any values for surface hardness (Hk), and certainly fails to disclose the presently claimed range. Further, the claimed range for surface hardness (Hk) is not the "automatic" result of forming a film having a surface roughness (Ry) and thickness (h) that fall within the claimed formula, as suggested by the PTO..

As with the rejections based upon Dam, the PTO has taken the position that knowledge of 2 variables (here surface roughness and film thickness) automatically results in

knowledge of the third variable (surface hardness). This is the same flawed reasoning as was applied in the rejections based upon Dam.

Applicants also note that the cover of the Coffinberry patent indicates that it is assigned to General Electric Company and that the disclosure appears to focus on problems caused by buildup of coke and gum on walls within jet and gas turbine engines. (See col. 2, line 65-col. 3, line 18). Although there is a passing reference to a fuel injector (See col. 3, line 14), there is no discussion of coating sliding structures within the fuel injectors or solving the problems addressed in the present patent application. The remainder of Coffinberry's disclosure discusses coatings on walls. (See col. 5, lines 13-25). Thus, Applicants submit that Coffinberry also fails to disclose "a hard carbon thin film coated on at least one of the sliding sections of the base materials of the needle valve and the opposite member" as recited in claim 1.

Applicants note that Haji has been cited for the laundry lists of fuel additives which it contains. However, Haji cannot resolve the basic deficiencies in Coffinberry, and Applicants submit, with particular regard to claims 2 and 3, that a person of ordinary skill in the art would not have been motivated to pick and choose from among the laundry lists of Haji to arrive at the presently claimed combination of features present in claims 1, 2, and 3.

With regard to claims 4-7, Applicants note that Coffinberry does not disclose the individual features defined in each of these claims and Haji, a reference directed to fuel additives, contains no disclosure relevant to any of claims 4-7 which are directed to hard carbon coatings and the surface to which a hard carbon coating is applied. Accordingly, Haji adds nothing to resolve these fundamental deficiencies in Coffinberry.

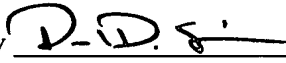
Applicants therefore submit that Coffinberry and Haji cannot properly render claim 1 obvious within the meaning of §103.

As a result, Applicants believe that the Examiner's rejections based upon Coffinberry and Haji are improper and should be reversed.

In view of the foregoing, Applicants respectfully request reversal of the outstanding rejection based upon Coffinberry and Haji.

Respectfully submitted,

Date May 16, 2007

By 

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Paul D. Strain  
Attorney for Applicant  
Registration No. 47,369



**CLAIMS APPENDIX**

1. (Original) A fuel injection valve comprising:
  - a needle valve including a base material;
  - an opposite member including a base material whose sliding section is in slidable contact with a sliding section of the base material of the needle valve in presence of fuel for an automotive vehicle; and
  - a hard carbon thin film coated on at least one of the sliding sections of the base materials of the needle valve and the opposite member, the hard carbon thin film having a surface hardness ranging from 1500 to 4500 kg/mm<sup>2</sup> in Knoop hardness, a film thickness ranging from 0.3 to 2.0 μm, and a surface roughness (Ry) (μm) which satisfies a relationship represented by the following formula (A):
$$Ry < (0.75 - Hk/8000) \times h + 0.0875 \dots (A)$$
where h is the thickness (μm) of the hard carbon thin film; and Hk is the surface hardness in Knoop hardness (kg/mm<sup>2</sup>) of the hard carbon thin film.
2. (Original) A fuel injection valve as claimed in Claim 1, wherein the fuel for an automotive vehicle contains at least one additive selected from the group consisting of an ester-based additive and an amine-based additive.
3. (Original) A fuel injection valve as claimed in Claim 2, wherein the at least one additive is at least one additive selected from the group consisting of octane booster, cetane booster, antioxidant, metal deactivator, detergent-dispersant, deicing agent, and corrosion inhibitor.
4. (Original) A fuel injection valve as claimed in Claim 1, wherein the hard carbon thin film contains hydrogen atom in an amount of not more than 0.5 atomic %.
5. (Original) A fuel injection valve as claimed in Claim 1, wherein the hard carbon thin film is a diamond-like carbon thin film.

6. (Original) A fuel injection valve as claimed in Claim 5, wherein the diamond-like carbon film is formed by an arc ion plating process.
7. (Original) A fuel injection valve as claimed in Claim 1, wherein the at least one of the sliding sections of the base materials of the needle valve and the opposite member has a surface roughness (Ra) of not more than 0.03  $\mu\text{m}$  in a condition before the at least one of the sliding sections is coated with the hard carbon thin film.

**EVIDENCE APPENDIX**

- NONE -

**RELATED PROCEEDINGS APPENDIX**

- NONE -